WOMAN'S INSTITUTE of DOMESTIC ARTS & SCIENCES

INC.

INSTRUCTION PAPER

With EXAMINATION QUESTIONS

SKELETON FOUNDATIONS

PART 1

By ORA CNÉ

FIRST EDITION

102 A

WOMAN'S INSTITUTE
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ADVICE TO THE STUDENT

Study a few pages at a time and in consecutive order. Pay particular attention to the definitions; a correct understanding of them is essential. If you do not understand any of the statements or if you meet with difficulties of any kind, write to us for assistance. It is our desire to aid you in every way possible.

After you have studied the entire Section, review the whole subject, then write your answers to the Examination Questions at the end of this Paper. All that is necessary is to give the answers and write in front of each the number of the question to which it refers.

WOMAN'S INSTITUTE OF DOMESTIC ARTS AND SCIENCES, INC.

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SKELETON FOUNDATIONS
(PART 1)

WIRE FRAMES

MATERIALS AND TOOLS REQUIRED

KINDS OF WIRE

1. The term **foundation,** in the language of the milliner, is used to designate the skeleton or framework that gives the hat or bonnet a definite shape; in other words, it is the frame on which the covering of silk, velvet, straw, net, etc., is placed and to which the covering is sewed. The frames commonly used in millinery shops are bought ready-made, in standard sizes and of shapes conforming to the styles of the season, and these are altered to suit the individuality of the wearer. But in spite of this fact, every one who aims to do millinery work should be able to construct a foundation of any desired size and shape. Such ability is valuable in case a frame already made is to be altered, or in case it becomes necessary to copy a hat for which no frame can be purchased, or to produce a perfect-fitting hat of special design. Frames are made of either wire or buckram; but as wire frames are the simpler, and as original models are frequently made in wire before being reproduced in buckram, their construction will be described in this Section. Wire is used to construct a skeleton foundation and buckram to make a so-called solid foundation.

2. The various kinds of wire ordinarily used in millinery work are illustrated in Fig. 1, which shows the actual sizes. **Tie wire** is used for tying together the wires forming the frame, at the points

where they cross, thus giving rigidity to the construction. It is a fine, soft-iron wire covered with silk in both black and white, and is wound on wooden spools. A nick should be cut in the edge of the flange at one end of the spool, and as soon as a piece of wire has been cut off, the free end should be pressed down into this nick. If this precaution is not taken, the natural elasticity of the wire will cause

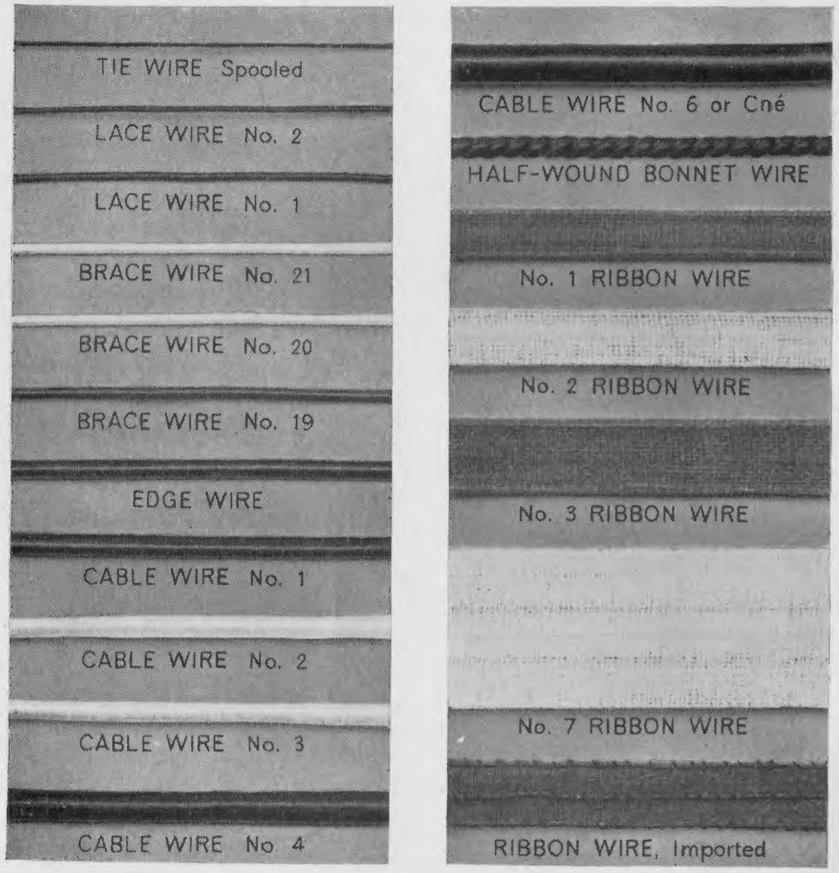

FIG. 1

it to spring out and the coils will rapidly unroll from the spool. There is another kind of tie wire, consisting merely of fine, uncovered soft-iron wire of the same size as that covered with silk; however, uncovered tie wire is not recommended. It is liable to rust, and is used only on the cheapest grades of work.

3. Lace wire, two sizes of which are shown in Fig. 1, is used to stiffen lace, maline, gauze ribbon, ribbon bows, etc., when these

materials are used as trimmings. It is also a silk-covered wire, and may be obtained in either white or black. The heavier size, No. 1, is sometimes used for constructing frames of bonnets for elderly ladies, because it is lighter than the wire ordinarily used for this purpose, and therefore causes less discomfort when the hair has thinned.

4. Brace wire, shown in three different sizes in Fig. 1, is the wire used in constructing the frame of a hat or bonnet. It is covered with silk, cotton, or mercerized cotton. The No. 21 size is commonly used in the better grades of hats. Brace wire can be obtained in a great assortment of different colors, but black and white are the only ones absolutely necessary for ordinary work. Frames of black wire are used for all hats made of dark-colored materials and frames of white wire for hats of light-colored materials. But if the light-colored materials are thin and transparent, the white-wire frame must be tinted to match the covering. If a large number of frames of a particular tint or shade are desired, it will then be found advisable to use brace wire of the same color. Brace wire is sewed on the edges of buckram brims to stiffen them; it is used to support heavy ribbon bows, ostrich plumes, flowers, and soft, flexible felt or straw brims; and it is sewed to brims and then bent so as to give desired curves.

5. Edge wire, shown in Fig. 1, is made of the same size of wire as brace wire but it is covered first with heavy, loosely woven cotton thread laid parallel to the wire, and then wound closely with silk. The result is a thick, padded wire to which materials can be sewed directly, and it is therefore used at the outer and inner edges of brims. It is made in all colors, but black and white are the ones principally employed, the latter being tinted, when necessary, to match the material.

6. Several sizes of **cable wire** are shown in Fig. 1, the higher numbers denoting the larger sizes. It is exactly the same as edge wire in its construction, but is heavier than edge wire because of thicker wrapping. It is sewed under material with a saddler's-stitch so as to make a rolled edge on a brim. Brace wire may be used in the same manner, if desired. The No. 6 or Cné cable is the largest size made and is used principally for finishing the edge of a hat or bonnet. Cable wire has a smooth, satiny appearance and is often used to form a finish on the edge or the under brim of a hat.

7. The **half-wound bonnet wire** shown in Fig. 1 is a plain wire embedded in soft cotton threads laid parallel to it and wound tightly with a single spiral of silk thread. It is a cheap wire and is not extensively used at the present time.

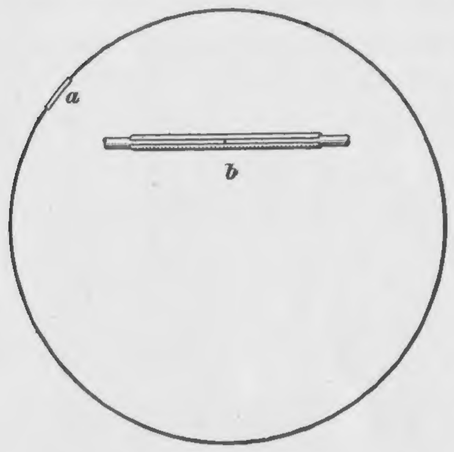

FIG. 2

8. Ribbon wire, several styles of which are shown in Fig. 1, consists of a strip of muslin folded over two small parallel wires and pasted down. The wires are thus held between the two thicknesses of muslin, at the edges, forming a ribbon, which, when bent to any particular shape, will retain that shape because of the wires. It is made of different widths and is used for stiffening and supporting ribbon bows, loops, and ends. The imported ribbon wire is different from the preceding forms, however. It has three cotton-covered wires, one at the middle and one at each edge, but instead of being pasted inside the ribbon, the wires and the filling are woven together at one time to form the ribbon.

9. Spring wire is strong and elastic and is used for the edge wire of very large hats and also for making medium-sized and large hats with brims in which no brace wires are used. The ends of the wire are not bound with tie wire but are slipped into a clip, or clamp, as shown at *a*, Fig. 2. An enlarged view of the clip with the ends in place is shown at *b*.

10. Lace wire, brace wire, edge wire, cable wire, and half-wound bonnet wire are not spooled but are purchased in coils, bound at two places with tie wire, as shown at *a* and *b*, Fig. 3. When the wire is to be used, the coil is held tightly while the binding wires *a* and *b* are being removed, then hung over the clasped right and left hands, and given a number of complete swings by moving the hands rapidly in a small circle. This operation is known

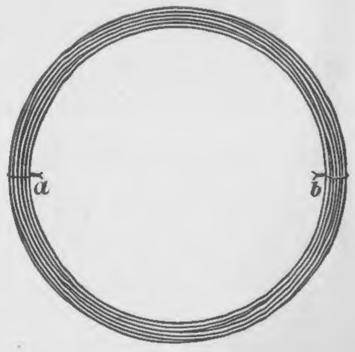

FIG. 3

as *springing the wire* and its object is to loosen the coils and let them spring out to a greater diameter. When the coil has sprung to about twice its original diameter, it should be dropped over a fruit jar set on the floor; or, the device shown in Fig. 4 may be made cheaply and easily to hold the wire. Take a block of wood *a*, 8 inches square or larger, and 1 inch thick and through the center drive a nail into the end of the pin *b* so as to hold the pin upright. This pin may be a piece of broomstick a foot long. In the top make a hole *c* with the point of a penknife. Drop the opened coil of wire *d* over the pin and stick the loose end *e* into the hole *c*. This prevents the wire from uncoiling farther, and also keeps the end of the wire where it can be picked up when needed, without searching for it among the loosened coils. Instead of gouging a hole *c* to receive the end of the wire, a screw eye may be screwed into the side of the pin near the top, and the wire may be put through it.

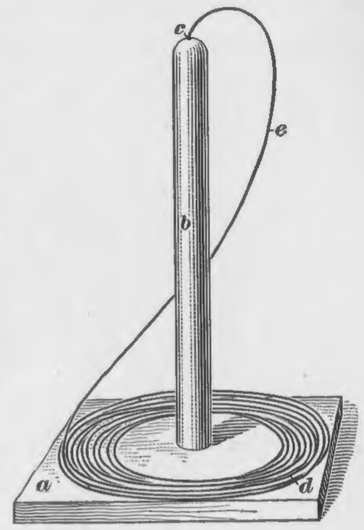

FIG. 4

TOOLS

11. The tool used for bending, twisting, and cutting wire when making frames is the **pliers,** shown in Fig. 5. The jaws *a* and *b* are roughened on the inner faces, as at *c*, so that they will not slip when gripping and twisting wires. At *d* and *e* are a pair of sharp cutting edges that are used for cutting wire. The hole *f* in the handle enables a cord or a ribbon to be tied to the pliers so that they can be hung from the belt of the apron, to prevent their being mislaid or lost. A rubber cord should *never* be used for this purpose, as the pliers may be caught accidentally by the skirt of some one in passing, and in springing back may cause serious injury. Pliers 5 inches long are a convenient size.

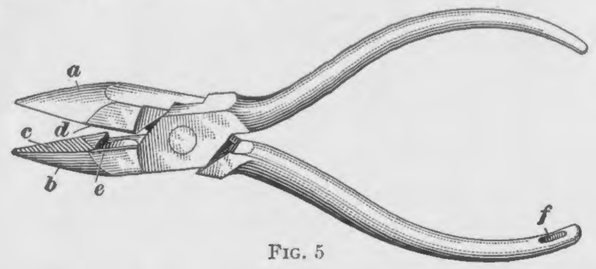

FIG. 5

12. The shears are frequently used for cutting tie wires. The method of doing this is shown in Fig. 6. The tie wire is wrapped a number of times around the first and second fingers, then one blade of the shears is inserted beneath the top of the coils, along the forefinger, and the several turns are cut across, as shown. The result is a number of short tie wires of equal lengths. After some experience has been gained, shorter tie wires can be used, in which case the coils around the two fingers are cut at both the top and the bottom. When frames are made in factories, on shapers or blocks formed particularly for them, the tie wire is not cut into lengths, but is

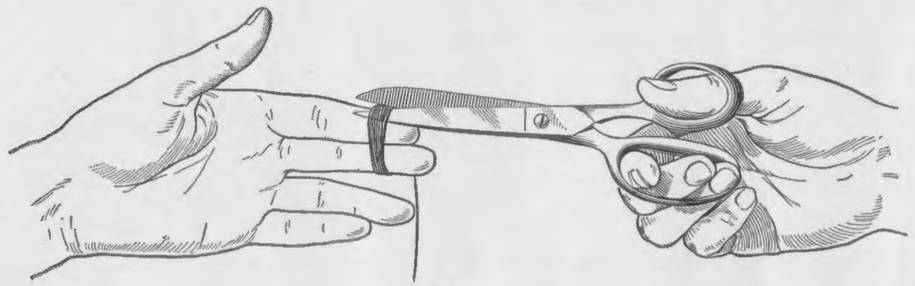

FIG. 6

used directly from the spool, from which it is cut after each tying operation. Uncovered tie wire is commonly used in tying factory-made frames.

The tape measure, also, is used considerably in the construction of wire frames, for measuring the lengths of wires, spacing brace wires, measuring the lengths of paper gauges, and so on. Because of the large number of measurements that must be given, the dimensions in inches or yards will be expressed by using abbreviations. The abbreviation for inches is *in.*, that for feet is *ft.*, and that for yards is *yd.*

CONSTRUCTION OF WIRE CROWNS

HEAD-SIZE

13. The most important consideration in either the making or the selection of a hat is to obtain a size that fits perfectly. Hats made for men are graded in sizes and numbered; but this is not the case with hats manufactured for women, except that, occasionally, sailor hats are made in three or four sizes. As a rule, all hats placed

on the market have one standard head-size. By **head-size** is meant the distance around the head, measured over the hair, to produce a perfect-fitting hat. Of course the head-size varies according to the size of the head and the style of dressing the hair. The

FIG. 7

head-size measuring 24 in. around has long been the standard or normal size, although it is not an uncommon thing to find many hats that measure 25, 26, and 27 in., and sometimes as large as 30 in. in the head-size. On account of this variation in sizes,

it has been necessary for milliners to use reducers or employ some other method of making the hat fit.

14. In making frames or selecting hats of any sort, an allowance must be made for the lining and the facing to be put in the hat. It will be found that a 24-in. head-size will fit the majority of women, or can be made to fit by wearing the hair in the proper style. If a frame is to be made for a hat, before measuring the head for the head-size the most important thing to do is to arrange the hair in exactly the manner in which it is to be dressed when the hat is worn. After the hair has been arranged, take a piece of No. 21 brace wire 30 in. long and place it around the head, over the hair, bringing the ends together and overlapping them, holding one end

FIG. 8

in each hand, as in Fig. 7. Do not draw it tightly, but leave it loose enough so that the finger can be pushed between the wire and the head all around. This makes allowance for the insertion of facing and lining after the frame has been finished. Then, still holding one end in the left hand, move the forefinger of the right hand to a point directly opposite the end held by the left hand. Next remove the wire from the head, and bring the end held by the left hand against the forefinger of the right hand. This brings the wire to the correct head-size, as measured before. Grasp the ends where they overlap and tie them together firmly with tie wires, as shown in Fig. 8, using the pliers to twist the tie wires. The end of the wire should be cut off so as to give an overlap of 3 in. The tying

should be done at two places, as *a* and *b*, ¼ in. from the ends of the overlapped wire.

15. If a considerable number of frames of a standard head-size are to be made, the wire is measured with a tape measure. Suppose, for example, that the head-size is to be 24 in. Take up the end of a coil of brace wire and hold the end of the tape measure even with it. Then, holding the two together, with the tape measure on top, slip the fingers along until the 24-in. mark is reached, and make a slight bend in the wire, as shown at *a*, Fig. 9. Then continue

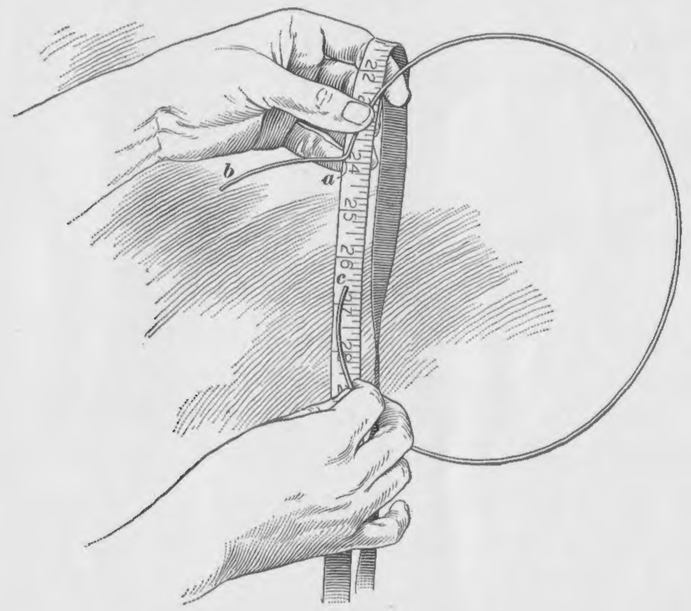

FIG. 9

3 in. farther, and cut the wire off at the point *b*. The distance *a b* then gives the necessary overlap for tying. Now bring the end *c* to the point *a*, bend the 3-in. piece down so that it will lie close to the head-size wire, and tie the two ends as explained in connection with Fig. 8.

DOME CROWN

16. The measurement of the correct head-size and the making of the head-size wire constitute the first steps in the construction of the crown or brim of a hat. The first example of frame making to be considered will be the construction of a **dome crown,** which is

shown completed in Fig. 10. Starting with the head-size wire *a*, made as already described, the next step is to bend and attach the four *support wires* *b*, *c*, *d*, and *e* that outline the dome. Before these wires can be attached, however, it is necessary to locate the points *f*, *g*,

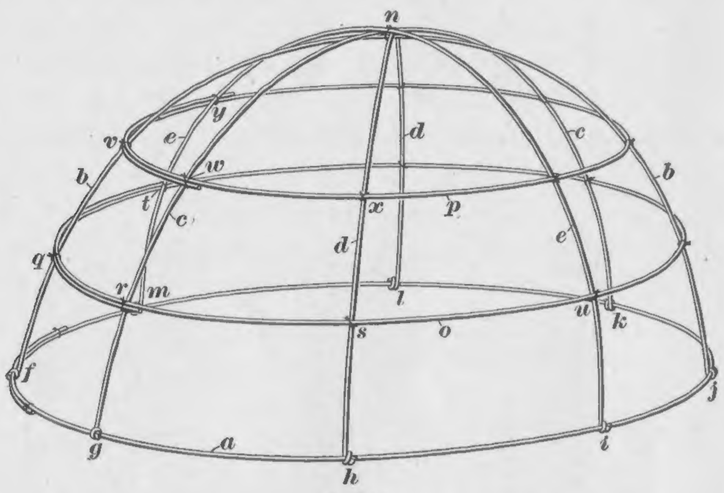

FIG. 10

h, *i*, *j*, *k*, *l*, and *m* at which the ends of the wires *b*, *c*, *d*, and *e* are to be fastened. These points are eight in number, since the four support wires have eight ends; also, the eight points are spaced at equal distances around the head-size wire *a*.

17. To mark off these equal distances, take a narrow strip of paper, and holding it against the head-size wire, run it around and tear it off so that its length is exactly equal to the head-size. Now fold this strip in the middle, then fold it a second time, and finally a third time. Straighten it out, and it will appear as in Fig. 11, with seven creases that divide it into eight equal parts. The first fold makes the crease *a*, and divides the strip into two equal parts; the second fold gives the creases *b* and *c* and divides it into quarters; and the third fold gives the creases *d*, *e*, *f*, and *g*, and divides it into eighths. Cut off one of these eighths, as the end *g h*, to use as a gauge in spacing the points on the head-size wire.

FIG. 11

18. The starting point from which to lay off the equal divisions on the head-size wire is the point *f*, Fig. 10, which is the middle of the

overlapped ends. This point is the middle of the back of the hat. Using the gauge *g h*, Fig. 11, lay one end of it at the point *f*, Fig. 10, and stretch it along the wire *a*, and even with its other end make a pencil mark, which will be the point *g*; from *g*, using the same gauge, mark off another division, thus locating the point *h*; and continue in the same way around the wire *a*. The point *j*, directly opposite *f*, will then be the front of the hat.

19. The next thing to do is to attach the wires *b*, *c*, *d*, and *e*, Fig. 10. These wires are all of the same length and have the same curvature. The height of the crown depends on the length of the wire used; the longer the wire, the higher will be the crown. But the height of crown may be varied according to the wearer. The

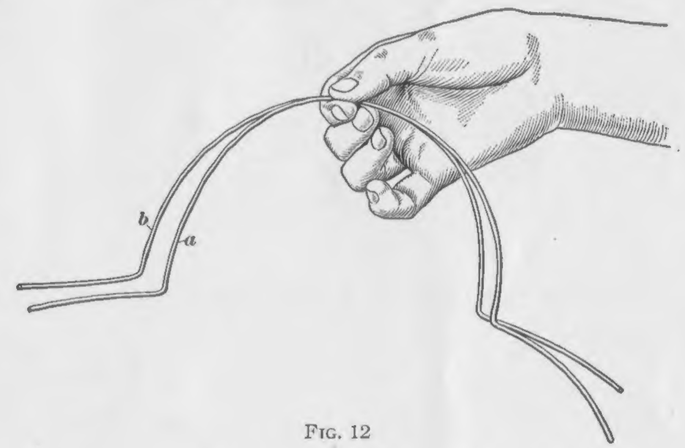

FIG. 12

object to be attained is correct proportion, or balance, and in this respect the beginner must use her judgment. A few trials with a wire bent to give a higher or a lower dome will soon indicate the length of wire to be used. When the desired length has been determined, three more wires of the same length should be cut off. The method of doing this is shown in Fig. 12. The wire *a* represents the one that has been selected as giving the correct height of crown. To obtain another like it, take the wire *b*, turn up one end to correspond with *a*, and then, using *a* as a gauge, draw both wires through the fingers until the bend at the other end of *a* is reached. At this point make a similar bend in *b*, and then cut off the wire *b* at a point 2 in. beyond the bend. The upturned ends of these wires are all 2 in. long. In the same way, measure and cut off two more wires like those at *a* and *b*. In this particular case, the length of each

support wire is 12 in., measured from one side of the crown to the other over the top *n*, Fig. 10. If each wire is given an extra 2 in. for

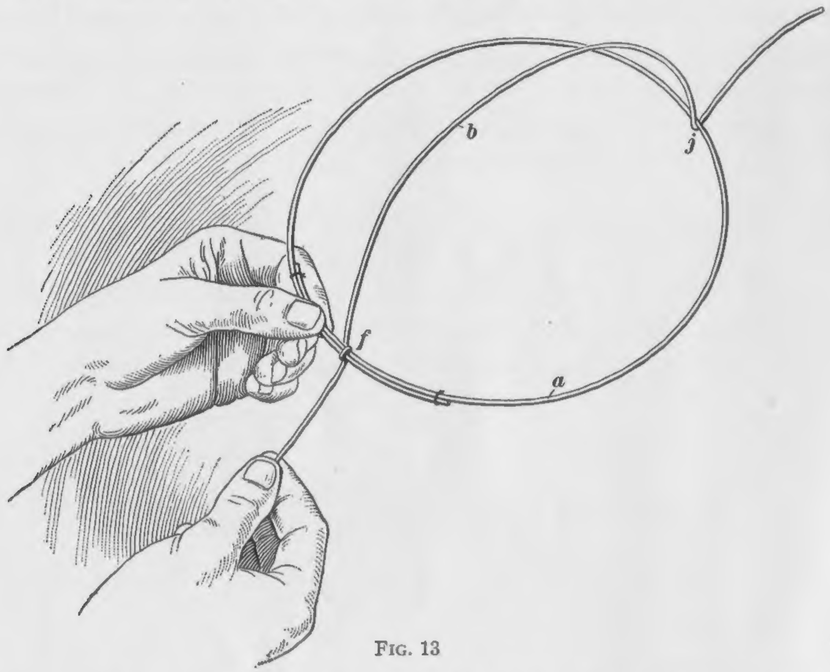

FIG. 13

twisting around the head-size wire, the total length of each must be 2+12+2=16 in.

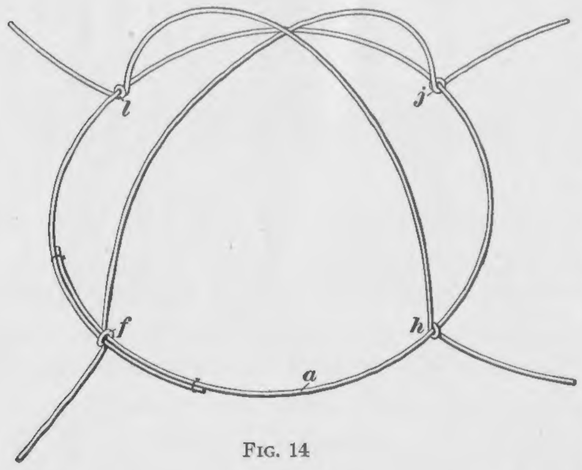

FIG. 14

20. To attach the support wires that have been prepared as just described, proceed as shown in Fig. 13. Take one of the support wires and begin at the point *f* at the back of the hat. Set the head-size wire *a* into the bend of the wire *b*, and give the short end one full turn around the wire *a*, as shown. Then do the same with the other end at the point *j*. The wire *b* will then be in position from the front to the back of the crown. Next, as shown in Fig. 14, take another wire and fasten it at the points *h* and *l*, which are the sides

of the hat. The dome will then appear as shown in the illustration, with the front-to-back and the side-to-side wires in place. Now take the remaining two support wires and fasten them in the same way from *g* to *k*, Fig. 10, and from *i* to *m*. When this has been done, the dome will appear as shown in Fig. 15. A piece of tie wire should be put around the crossed wires at the top *n* of the dome and twisted tight with the pliers, so as to hold the support wires firmly. The point *n* must be exactly at the middle of each of the support wires.

21. To brace the frame and make it sufficiently rigid, the wires *o* and *p*, Fig. 10, must be put on and tied fast. The wire *o* is put around the dome exactly 1½ in. above the head-size wire *a*. Cut a strip of

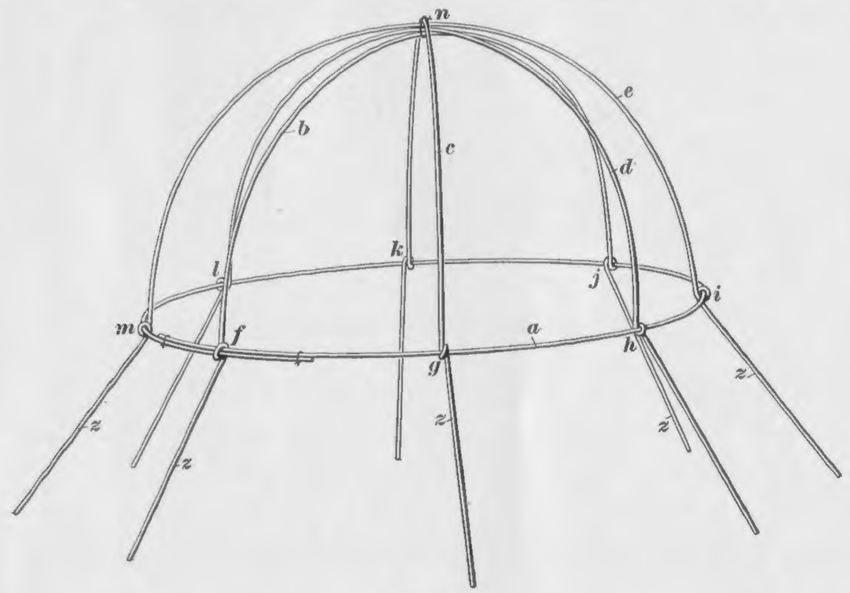

FIG. 15

paper 1½ in. long to be used as a gauge, and measure up from the points *f*, *g*, *h*, etc., and mark the points *q*, *r*, *s*, etc., around to *t*. Now take a piece of brace wire and fasten one end loosely at *t* with a piece of tie wire. Carry the wire around past the points *q* and *r* and fasten it with a tie wire at *s*; proceed to *u* and tie it to the wire *e*; and so continue around to *t*, tying it to the wires *b*, *c*, and *d*. At the point *t*, remove the loose tie wire used first, and tie both parts of the brace wire to the wire *e*, as shown. Stretch the wire to the point *q* and tie both parts to the wire *b*. Then stretch it past the point *r*, cut it off, and tie the double wire at *r* to the wire *c*. Now take the 1½-in. gauge, and from the points *q*, *r*, *s*, etc., mark off the

points *v*, *w*, *x*, etc., around to *y*. Then, beginning at *y*, attach the wire *p* in the same manner as the wire *o* was fastened. The wires *o* and *p* are known as *brace wires*.

22. When the wires *o* and *p*, Fig. 10, have been tied to the support wires, the frame of the dome crown is completed; however, the ends *z*, Fig. 15, of the support wires still project, as shown. Each of these ends should now be bent around until it stands up beside its corresponding support wire, after which it should be cut off with the pliers

FIG. 16

close to the head-size wire *a*. When this has been done, the frame will appear as shown in Fig. 10. Now it is necessary to go over the entire frame and tighten all the twists and tie wires. First press all the twists *f*, *g*, *h*, etc., between the jaws of the pliers in the manner indicated in Fig. 16. This not only turns the cut ends in but also flattens the loops against the head-size wire and prevents the ends of the support wires from moving sidewise. Finally, with the points of the jaws, grip each tie wire and twist it tight. The frame will then be bound together firmly and will be as rigid as it can be made. Absolute accuracy in spacing the wires is not necessary, because the

frame will be completely covered and hidden when the hat is finished. On the other hand, the beginner should not allow herself to fall into the habit of doing slipshod, inaccurate work. Less than 5 yd. of brace wire is needed for making the frame shown in Fig. 10.

BOX CROWN

23. The second example in the making of wire frames is the construction of a **box crown,** shown completed in Fig. 17. As before, the first step is to make the head-size wire *a*, which is done exactly as described in connection with Figs. 7 and 8. In this particular case, the head-size is 24 in., so that the head-size wire *a*, Fig. 17, is first made in the form of a circle and is then stretched to an oval measuring $8\frac{1}{2}$ in. from front to back and 7 in. from side to

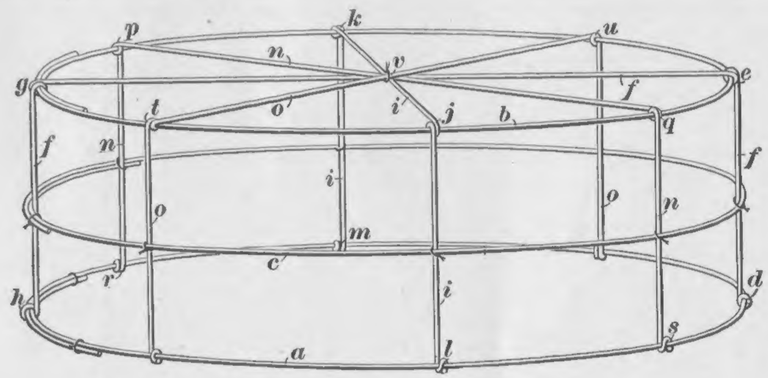

FIG. 17

side. The sides of the crown are straight; therefore, the top brace wire *b* is of the same size and shape as the head-size wire *a*. Midway between them is a brace wire *c*, of the same size and shape. Hence, using the head-size wire *a* as a pattern, cut two more wires of the same length, bind them with tie wires and bend them to the same shape as the head-size wire *a*, that is, to an oval $8\frac{1}{2}$ in. long by 7 in. wide. Four support wires are used, spaced equally around the frame; therefore, by means of a strip of paper folded into eighths and used as a gauge, as explained in connection with Fig. 11, the top brace wire *b*, Fig. 17, and the head-size wire *a* are marked off into eight equal divisions, beginning at the points *g* and *h*, which are the middle points of the overlapping ends and are at the back of the crown.

24. The height of a box crown may vary from 1 to 5 in., but in this example a medium height of 3 in. will be used; that is, the distance *g h*,

Fig. 17, is 3 in. The support wire *f* from back to front should be attached first. The length *e g* is $8\frac{1}{2}$ in., and the distances *d e* and *g h* are each 3 in. long. But, the wires *d e* and *g h* must be longer than 3 in. to give ends long enough so that the twists at *d* and *h* can be made easily; hence, each end would be made 5 in. long. Then, the length of the wire *f* would be $5+8\frac{1}{2}+5=18\frac{1}{2}$ in. Cut off this length of No. 21 brace wire and at each end bend down a piece 5 in. long. Lay this across the top brace wire *b* from *e* to *g* and twist each end once around the wire *b*. The crown will then appear as shown in Fig. 18. Cut a strip of paper exactly 3 in. long to use as a gauge, measure off the height of the crown from *e* to *d* and bend the wire *f* outwards at *d*, as shown by the dotted line; then do the same thing at *h*.

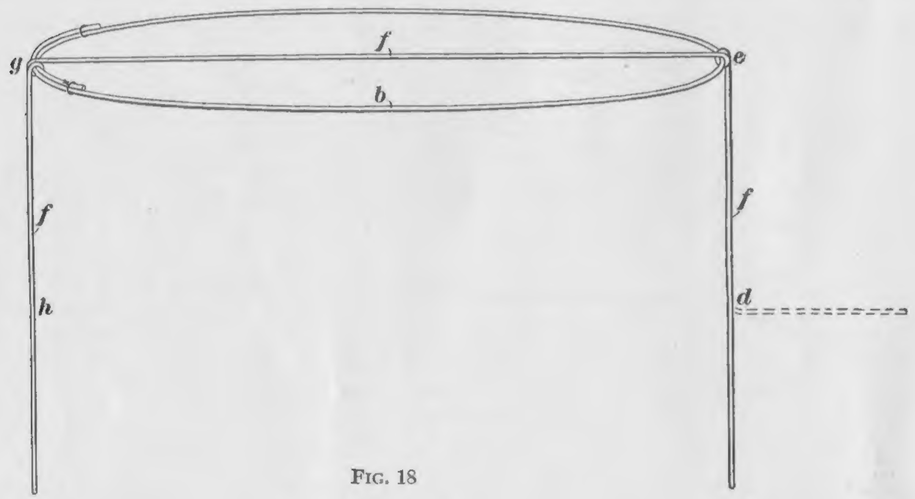

FIG. 18

25. Next, prepare the support wire *i*, Fig. 17. The distance *j k* from side to side is 7 in., and each end must be 5 in. long, including the allowance for bending; hence, the wire *i* must have a length of $5+7+5=17$ in. Cut off a piece of brace wire 17 in. long and bend down a piece 5 in. long at each end. Lay this across the top brace wire *b* between the middle points of the sides, or from *j* to *k*, and give each end a complete turn around the wire *b*. Using the 3-in. strip of paper as a gauge, turn up the ends at *l* and *m*, as was done with the wire *f* in Fig. 18. Then take the head-size wire *a*, Fig. 17, set it into the bends *l* and *m* of the support wires, and give the end of each support wire a full turn around the head-size wire. Then cut off the ends close to the head-size wire. Proceed in the same way with the ends of the support wire *f* at *d* and *h*.

The support wires *n* and *o* are not measured and bent before being attached, as were the wires *f* and *i*. Instead, two pieces of brace wire 18 in. long are cut off and straightened out. One of these is laid across from the mark *p* to the mark *q*, and the ends are then bent down over the wire *b*. Care must be taken not to bend the top brace wire *b* inwards, but to let it retain its correct form. Twist the wire *n* around the top brace wire at *p* and *q* and bend the ends down. Measure off 3 in. on each with the paper gauge used before, bend the ends around the head-size wire at the points *r* and *s*, and cut them off close. Take the other 18-in. piece of wire for the wire *o*, lay it across from *t* to *u* and fasten it to the top brace wire and the head-size wire in the same manner as was done with the wire *n*.

26. The support wires are now in position, and they must be bound together at the middle point *v*, Fig. 17, where they cross. This is done with a piece of tie wire. It now remains to put the brace wire *c* on the frame. This wire was made at the same time as the top brace wire *b* and the head-size wire *a*, and of the same size and shape. It is fastened to the wires *f*, *i*, *n*, and *o* midway between the top brace wire and the head-size wire. The height of the crown, or the distance between the top and bottom, is 3 in.; hence, to locate the wire *c* at the mid-height of the crown, a strip of paper $3\div 2=1\frac{1}{2}$ in. long is cut as a gauge. Then, from the points *h*, *l*, *s*, *d*, etc., distances of $1\frac{1}{2}$ in. each are laid off upwards on the wires *f*, *o*, *n*, and *i* and the wires are marked. The marks thus made are $1\frac{1}{2}$ in. from the top of the crown, or half way down the side. The brace wire *c* is now slipped over the head-size wire *a* and pushed up over the wires *f*, *i*, *n*, and *o* to the middle points marked on them, where it is tied by tie wires, as shown. The overlapping ends of the brace wire *c* must be placed at the back of the hat. The final steps are to press all the twists at *h*, *l*, *s*, *d*, etc., with the pliers, to keep the support wires from slipping, and to twist all the tie wires tightly. The frame is thus made rigid.

27. In the foregoing description of the making of a box crown, the various measurements are based on a 24-in. head-size, and these particular dimensions can be used only for a crown of that size. If a box crown is to be made for any other head-size, the dimensions will be different; but the method of procedure will be exactly the same, since the various operations are the same and are performed in the same order. Five yards of brace wire will make this crown.

BELL CROWN

28. A completed **bell crown** is shown in Fig. 19, and the method of making it is very much like that used in making the box crown just described. Measure off the correct head-size wire *a* and tie the overlapping ends as shown. Make a paper gauge as explained in connection with Fig. 11, and mark off the points from *b* to *i*, Fig. 19, around the head-size wire, dividing it into eight equal parts. Next make the top brace wire *j*. This is a circle, and its size depends on the amount of flare to be given to the crown; the more pronounced the flare, the larger must be the circle of the top brace wire. In

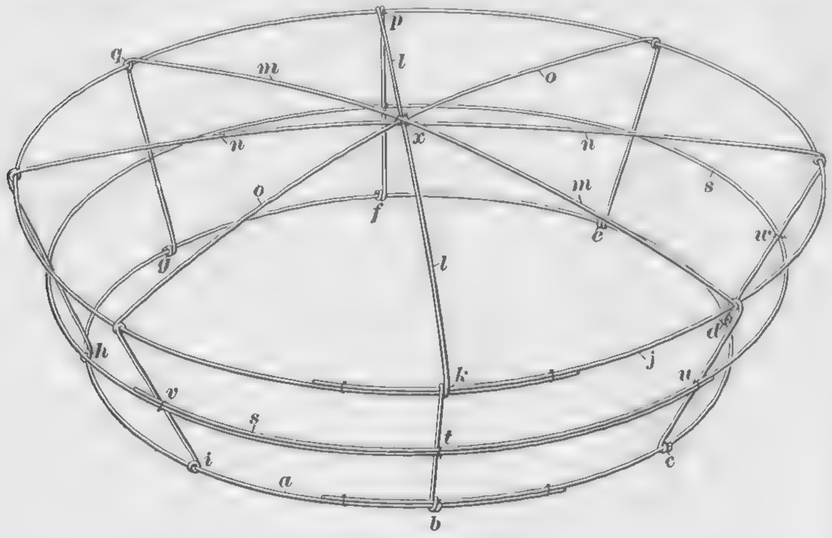

FIG. 19

this particular case, a 24-in. head-size wire and a 30-in. top brace wire are used, and the height of the crown, measured from *b* to *k*, is $2\frac{1}{2}$ in. Take a piece of brace wire 33 in. long, bend it to a circle with the ends overlapping 3 in., and tie them together, thus making the top brace wire *j* 30 in. around. Now take a strip of paper of the same length, fold it as in Fig. 11, and mark off the top brace wire *j*, Fig. 19, into eight equal parts, beginning at *k*, the middle of the overlapping ends.

29. The support wires *l*, *m*, *n*, and *o*, Fig. 19, are all of the same length. The length *k p* is $9\frac{1}{2}$ in., *f p* and *b k* each measure $2\frac{1}{2}$ in., and 2 in. must be added at each end to allow the wire to be bent around the head-size wire easily at *b* and *f*. Therefore, the total

length of the wire *l* must be $2+2\frac{1}{2}+9\frac{1}{2}+2\frac{1}{2}+2=18\frac{1}{2}$ in. The wires *m*, *n*, and *o* are now cut to the same length. Turn down $2+2\frac{1}{2}=4\frac{1}{2}$ in. at each end of each of these wires, and the distance between the bends will be $9\frac{1}{2}$ in., or the distance across the top brace wire. Lay the support wire across the circle *j* from *k* to *p*, bend the ends around the wire *j* at *k* and *p*, and turn them downwards and inwards a trifle. Now attach the wires *m*, *n*, and *o* in the same manner, at the equally spaced points that were marked on the wire *j*. When this has been done, the crown will be completed to the stage shown in Fig. 20, in which the length of each end projecting down from the wire *j* is $4\frac{1}{2}$ in.

30. Now, on each of the projecting ends of the support wires in Fig. 20, with a piece of paper $2\frac{1}{2}$ in. long as a gauge, measure down

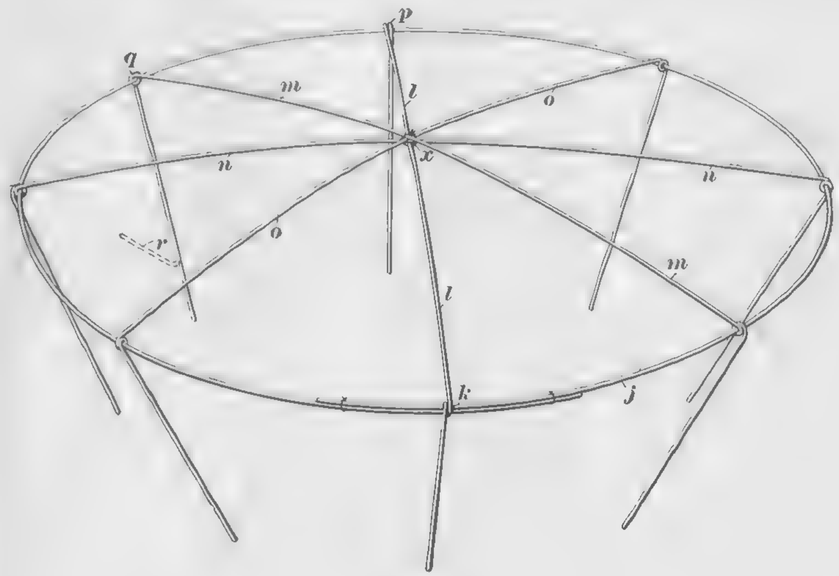

FIG. 20

from the points *k*, *p*, *q*, etc., all around, and turn up the wires, as indicated by the dotted line at *r*, thus making the distance *q r*, and the corresponding distance on each of the other wires, exactly $2\frac{1}{2}$ in. Then take the head-size wire already made, and set it into the bends made in these projecting ends, taking care to have the overlap in the head-size wire come directly under the overlap in the top brace wire as shown in Fig. 19. Twist the ends of the support wires around the head-size wire, as shown, at the equally spaced points *b*, *c*, *d*, etc., and cut them off close. The crown is now completed except for the

addition of the brace wire *s*, which is to be put midway between the top brace wire and the head-size wire. The half of $2\frac{1}{2}$ in. is $1\frac{1}{4}$ in.; so cut a piece of paper $1\frac{1}{4}$ in. long as a gauge, and measuring with it from the points *b*, *c*, *d*, etc., upwards on the support wires, mark the points *t*, *u*, etc., around to *v*.

31. Tie one end of a piece of brace wire loosely at *v*, Fig. 19, carry it around to the mark *w* and tie it to the support wire *n*, and continue thus around to *v*, tying it at each point where it crosses the support wires. Loosen the tie wire first put on at *v*, and tie again at this point, over *both* wires. Tie both wires to the wire *l* at *t* and to the wire *m* at *u*, and cut the brace wire off $\frac{1}{4}$ in. beyond *u*. At the middle point *x*, where the four support wires cross, tie them together firmly with a piece of tie wire. Finally, go over all the twists at *b*, *c*, *d*, etc., around the head-size wire and press them with the pliers, and tighten all the tie wires by twisting. The frame will then be finished. Five yards of brace wire will be ample for this crown.

It must be remembered that the measurements that have been used are for a 24-in. head-size, a 30-in. top brace wire, and a $2\frac{1}{2}$ in. height, measured along the slope. If any other size of crown is made, the dimensions will be changed and the lengths of the various wires must be altered accordingly; however, the method given can be applied to the construction of any crown of this type. If it is desired to give the crown a slight rise at the center, so as to make it curved instead of flat on top, the support wires should be made $\frac{1}{4}$ in. longer than the distance across from *p* to *k*.

APEX CROWN

32. The **apex crown,** shown in Fig. 21, is circular in form, with the support wires bent so as to produce a conical top. The method of construction is a combination of exact measurement and trial. The head-size wire *a* is made in the manner already described, and the top brace wire *b* is made exactly like it. The four support wires that form the pointed crown are exactly alike, but it is necessary to take a piece of wire and make a few trials, first, to determine just what height of top crown is desired. The shorter the wire used, the lower will be the crown. These support wires are bent sharply at the middle, and the halves of each wire are alike. To use an actual

example, suppose that the head-size wire *a* is 24 in. long. The wire *b* is then of the same size. For this head-size, the height *c d* of the side

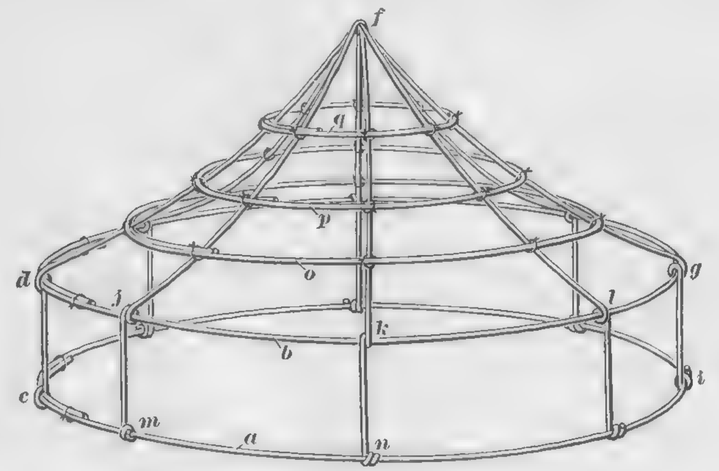

FIG. 21

crown may be made $1\frac{1}{2}$ in., which will give good proportions; and the height of the apex *f* may be 3 in. above the center of the top brace-wire circle *b*. These are the actual measurements of the frame that is shown in the illustration.

33. To make a crown of the dimensions stated in the foregoing

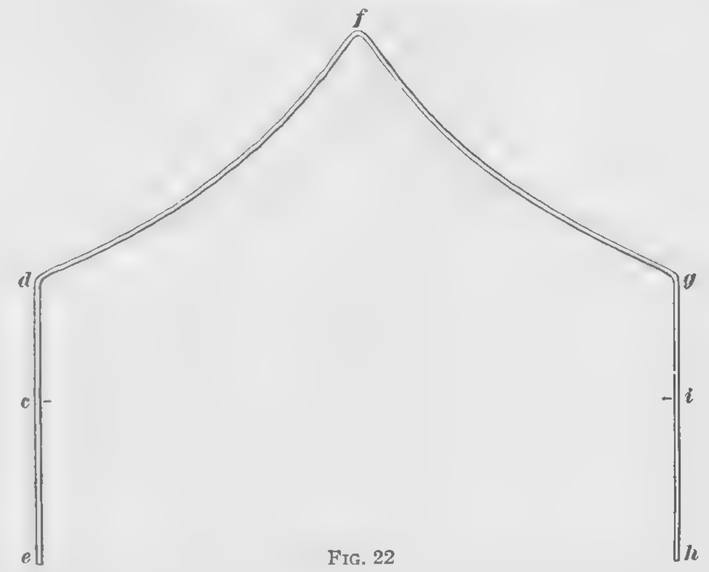

FIG. 22

article, the four support wires are made as shown in Fig. 22. Starting at the end of a piece of brace wire, mark off a piece *e d* $3\frac{1}{2}$ in.

long and make a bend at *d*. This length includes a 2-in. piece *e c* for twisting around the head-size wire and a $1\frac{1}{2}$ in. piece *c d* that gives the height of the side crown. From *d* measure off 5 in. to the point *f*, which corresponds to the apex of the crown. Here make a sharp bend, directly opposite to the direction in which the wire is naturally bent in the coil. Make the length *f g* also 5 in., and bend the wire at *g*. Finally, measure off *g h* $3\frac{1}{2}$ in. and cut the wire from the coil at *h*. The part *g i* is $1\frac{1}{2}$ in. and the part *i h* is 2 in., these parts giving the height of the side crown and the end for twisting, respectively. Make four support wires of these dimensions.

34. Take the top brace wire and the head-size wire, Fig. 21, and mark off each into eight equal divisions with a paper gauge made as previously explained, beginning the marking at the middle points *c* and *d* of the overlapped ends. Now take the support wire that has been bent as in Fig. 22 and set it on the top brace wire so that its bends *d* and *g* rest on the marks *d* and *g*, Fig. 21. Twist the ends around the top brace wire at *d* and *g* and let the ends project downwards. Attach each of the other three support wires in the same way, twisting them around the top brace wire at *j*, *k*, *l*, etc. Now take a $1\frac{1}{2}$-in. strip of paper as a gauge and mark off the height of the side crown from the points *d*, *j*, *k*, *l*, etc., downwards on the ends of the support wires, and bend these wires outwards at the points thus marked. Next take the head-size wire *a* and set it in place on these bent support wires, with the point *c* directly below *d*, twist the ends of the support wires around it at the points *c*, *m*, *n*, etc., that have been marked, and cut off the ends close to the wire *a*. Press the twists *c*, *m*, *n*, etc., firmly with the pliers and tie the support wires securely with a piece of tie wire at *f*. It now remains to add the brace wires *o*, *p*, and *q*. The brace wire *o* is 1 in. from *b*; the wire *p* is 1 in. from *o*; and the wire *q* is 1 in. from *p*. Marks are made on the support wires to indicate where the brace wires should be tied, using a 1-in. paper strip as a gauge. The wires *o*, *p*, and *q* are attached in the same manner as the brace wire *c*, Fig. 17, as already explained. The final step is to go over all joints and tie wires and tighten them. Less than 5 yd. of brace wire will be required for this crown.

SQUARE CROWN

35. The crown illustrated in Fig. 23 is known as a **square crown.** It is made up of seven wires, and all the bends in these wires are at right angles. The square crown described here is 7 in. square, $2\frac{1}{2}$ in. high, and measures 10 in. across from corner to corner diagonally. The three brace wires *a*, *b*, and *c* form squares measuring 7 in. on a side. To make the square of brace wire *c*, for example, measure off a length of 5 in. and bend it at right angles, forming the bend *d*; measure off three lengths of 7 in. each, and make a bend at each point, forming the bends *e*, *f*, and *g*; and then from *g* measure off 5 in. and cut the wire. Now overlap the two 5-in. ends so that

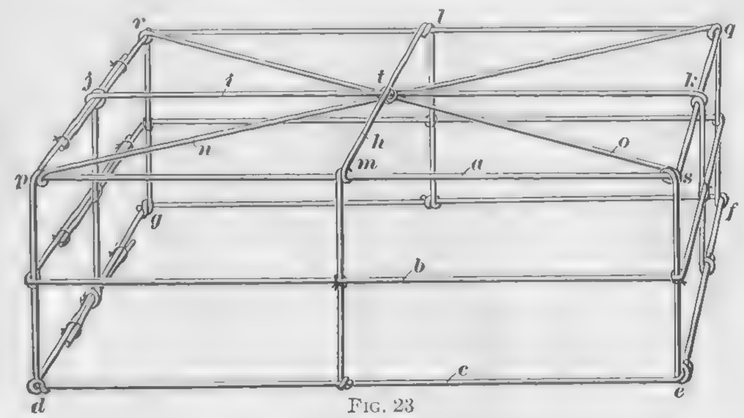

FIG. 23

the overlap is 3 in., and tie them together with tie wires, as shown. The square will thus be formed, and the length *d g* will be 7 in. The brace wires *a* and *b* are formed in exactly the same way.

36. The two support wires *h* and *i*, Fig. 23, are of the same size and shape. To make each, cut off a piece 16 in. long, and bend each end down at a point $4\frac{1}{2}$ in. from the end. The distance between the bends will then be 7 in., or the distance across the crown, and the $4\frac{1}{2}$-in. ends will be long enough to give a height of $2\frac{1}{2}$ in. to the crown and allow 2-in. ends for making the twists. Take the top brace wire *a* and mark the middle points of the four sides, as *j*, *k*, *l*, and *m*, using as a gauge a strip of paper equal to the length of one side, folded in the middle; and do the same to the bottom brace wire *c*. Then take the support wire *h*, which has been bent as just described, lay it across from *l* to *m*, and twist it around the top brace wire at *l* and *m*, allowing the ends to project straight downwards. Take the

similar support wire *i*, lay it across from *j* to *k* and twist it around the brace wire at *j* and *k*. The next step is to make the diagonal support wires *n* and *o*. The diagonal distance across the crown is 10 in., and each end must be $4\frac{1}{2}$ in. long; therefore, each of the wires *n* and *o* is made from a piece of brace wire 19 in. long with $4\frac{1}{2}$ in. bent down at each end. These support wires are laid across from *p* to *q* and *r* to *s* and twisted around the top brace wire at these points, as shown.

37. The four support wires have now been attached to the top brace wire *a*, Fig. 23, and the eight ends, each $4\frac{1}{2}$ in. long, extend downwards from the brace wire. Take a paper gauge $2\frac{1}{2}$ in. long, measure off the height of the crown on each of these ends, from the points *p*, *m*, *s*, etc., and bend the ends outwards. Then take the brace wire *c*, lay it on these bent support wires with the overlapped ends under those of the wire *a*, and twist the support wires around the lower brace wire *c* at the corners and the middle points of the sides. Cut off these ends close to the wire *c* and press the twists tight with the pliers. Next, take the brace wire *b* and tie it to the support wires along the side crown, exactly half way between the top and bottom brace wires *a* and *c*. This distance can be judged by eye, after a little experience has been gained; otherwise, the points at which the tie wires are to be fastened can be marked by using a paper gauge $1\frac{1}{4}$ in. long and marking the support wires below the points *p*, *m*, *s*, etc. Tie the support wires together at the point *t* and then go over all the tie wires and tighten them. The square crown can be made with 5 yd. of brace wire.

TRIANGLE CROWN

38. The **triangle crown,** shown in Fig. 24, is different from the types that have been described thus far, because it has only three support wires. The head-size wire *a* is 24 in. around and is made in precisely the same manner as the head-size wires of the preceding crowns. The top brace wire *b* and the middle brace wire *c* are triangles, each side of which is 8 in. in length. The lengths of the brace wires and of the head-size wire are the same, therefore, or 24 in. Consequently, the brace wires are made at the same time as the head-size wire, and exactly like it, and the two extra circles are then bent to form triangles. To form the top brace wire *b*, for example,

take one of the 24-in. circles, measure 4 in. on each side of the middle point *d* of the overlapped ends, and bend the wire at these points *e* and *f*. Measure off 8 in. from *e* to *g* and bend the wire at *g*. Now straighten the wire between the bends, and the top brace wire is formed. The middle brace wire is formed in the same way, but the sides are not straightened, as they must curve outwards slightly, to fit well around the support wires.

39. The three support wires *h*, *i*, and *j*, Fig. 24, are of the same shape and length. The distance *d g* across the top of the crown is 7 in., and the height *d k* is 3 in. Allowing 2 in. at each end for twisting around the head-size wire *a*, the length required for each support wire is 2+3+7+3+2=17 in. Take three pieces of brace wire each 17 in. long, and at each end of each wire bend down a piece

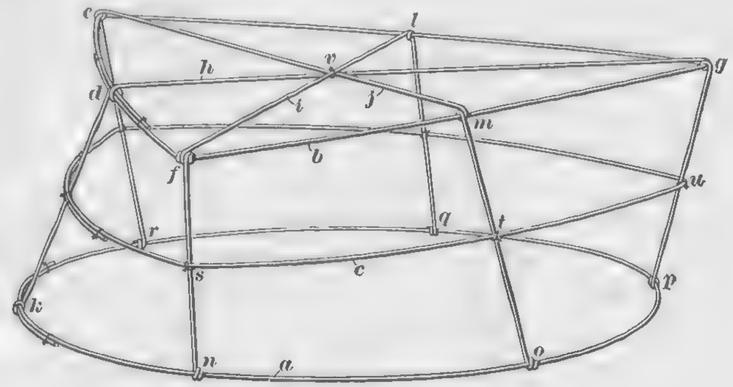

FIG. 24

5 in. long. The distance between the bends will then be 7 in., corresponding to the distance *d g*, and each of the 5-in. ends will allow 3 in. for the height *d k* and 2 in. for twisting. Take one of these support wires, lay it across from *d* to *g*, twist it around the top brace wire at *d* and *g*, and bend the ends down. Do the same thing with the other two support wires at the points *f* and *l*, and *e* and *m*. There will now be six ends of support wires projecting down 5 in. below the top brace wire *b*. Make a paper gauge 3 in. long, measure down 3 in. along each of the six ends, and turn up the remaining 2-in. piece on each. Then the frame is ready to have the head-size wire *a* attached.

It may happen, during the making of a frame, that the wire will break accidentally, or the covering will be torn off and necessitate cutting out the bare part. When such an emergency occurs, the wire

should not be spliced nor should its ends be twisted together; instead, the plan followed at *f* should be adopted. The broken end is twisted around the top brace wire at *f* and the extra length is cut off, after which a new piece is twisted around the top brace wire beside the twist just made at *f*, and then carried down to *n*. If the break had occurred between *l* and *f*, the broken end would have been cut off after twisting at *l*, and the new wire would have been started beside it at that point.

40. There are six ends to the support wires in the triangle crown, Fig. 24, and so the head-size wire must be divided into six equal parts. It is 24 in. around, and one-sixth of 24 is 4, so that a paper gauge 4 in. long can be used. If some other head-size than 24 in. is employed, a strip of paper should be cut to the exact head-size, then folded into three equal parts, and one of these three parts should be folded in the middle. One-half of one of these three equal parts is then the correct length of gauge needed to divide the head-size into six equal parts. Begin at the point *k*, and mark the points *n*, *o*, *p*, etc. Lay the head-size wire *a* on the bent-up ends of the support wires, with the point *k* directly beneath *d*, and twist the ends of the wire *h* around the head-size wire at *k* and *p*. Twist the ends of the other support wires around the head-size wire at the other points *n*, *o*, *q*, and *r*. Now take a paper gauge $1\frac{1}{2}$ in. long and mark the points *s*, *t*, *u*, etc., midway between the top brace wire *b* and the head-size wire *a*. Put on the middle brace wire *c* and tie it fast at the points *s*, *t*, *u*, etc., add a tie wire at *v* to hold the support wires together, cut off the ends of the support wires close to the head-size wire *a*, flatten the twists with the pliers, tighten all the tie wires, and the crown is finished. It can be made with 4 yd. of brace wire.

ACORN CROWN

41. The form of crown shown in Fig. 25 is known as the **acorn crown,** and the method of making it with a 24-in. head-size is as follows: Make the head-size wire *a* as for the preceding crowns, and mark it off into eight equal parts with a paper gauge, beginning at the middle point *b* of the overlapped ends. There are four support wires, and the distance from *b* to *c*, measured along the curve of the wire, is 7 in. Allowing 2 in. at the end of each half of a support wire for twisting around the head-size wire *a*, the length of each

support wire must be $2+7+7+2=18$ in. Cut off a piece of brace wire of this length, bend it exactly in the middle, or 9 in. from the ends, and bend in each end at a point 2 in. from the end. Using this piece as a pattern, bend and cut off three more support wires exactly like it. Then fasten the four wires to the head-size wire *a* at the points that were marked off on that wire by the use of the gauge. When all four wires have been fastened, cut off the ends close to the

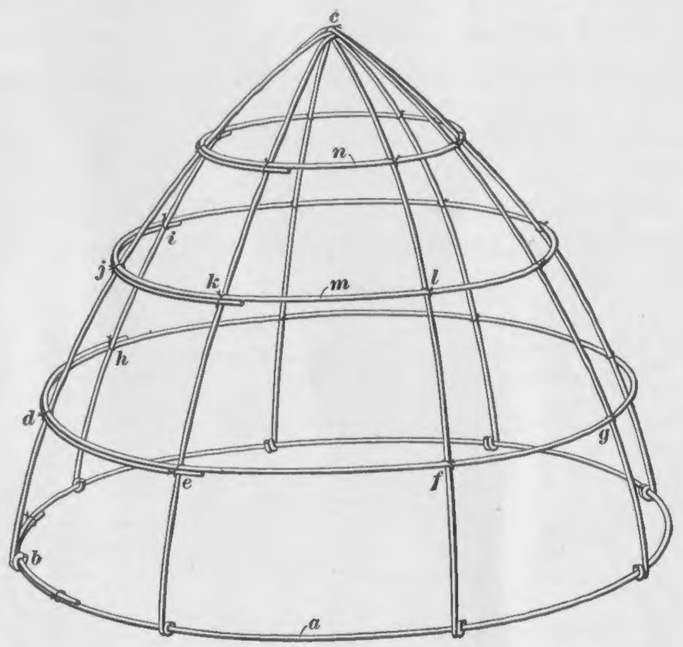

FIG. 25

head-size wire, press the twists firmly with the pliers and then draw the top bends together at *c* with a piece of tie wire.

42. As the distance from *b* to *c*, Fig. 25, is 7 in., three brace wires must be added in order to give sufficient strength to the frame. These three brace wires are equally spaced; therefore, take a strip of paper, cut off a length of $7\div4=1\frac{3}{4}$ in. as a gauge, and with it mark off the points *d*, *e*, *f*, *g*, etc., around to *h*, at a distance of $1\frac{3}{4}$ in. above the head-size wire *a*. Tie one end of a piece of brace wire loosely at *h*, stretch the wire around to *f*, and tie it there with a piece of tie wire. Tie it at the point *g* with tie wire, and continue around to *h*. Then remove the loose tie wire at *h* and tie *both* parts of the brace wire to the support wire *i*. At *d* tie both wires to the support wire, and stretch the brace wire to the point *e*. Cut it from the coil $\frac{1}{4}$ in.

beyond *e*, and twist a piece of tie wire around both brace wires and the support wire at *e*. Now take the $1\frac{3}{4}$-in. paper gauge and mark off the points *j*, *k*, *l*, etc., above the points *d*, *e*, *f*, etc., and then fasten the brace wire *m* in place in the same manner as that just described. Again use the $1\frac{3}{4}$-in. gauge to mark the position of the brace wire *n*, and fasten it to the support wires. Finally, go over the frame and tighten all tie wires. Less than 5 yd. of brace wire is required for this frame.

SQUARE CROWN WITH CIRCULAR HEAD-SIZE WIRE

43. A crown having a circular head-size wire and a square top is shown in Fig. 26. The head-size wire *a* is 24 in. around and is made in the usual way, with a 3-in. overlap. The square top brace wire *b* measures 6 in. on each side, and the height *c d* is 3 in. The

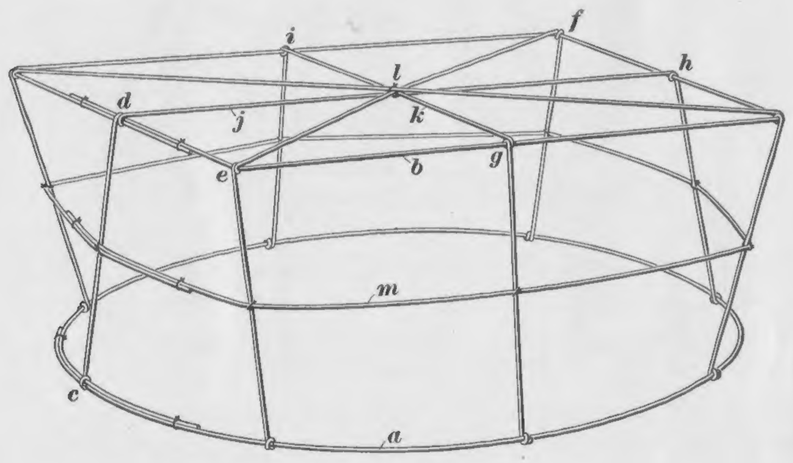

FIG. 26

distance *e f* from corner to corner, diagonally, on top of the crown, is $8\frac{1}{2}$ in., and from side to side or from front to back is 6 in. Allowing 2 in. at each end of each support wire for twisting around the head-size wire, the length of each diagonal support wire will be $2+3+8\frac{1}{2}+3+2=18\frac{1}{2}$ in., and the length of the front-to-back and side-to-side support wires is $2+3+6+3+2=16$ in. A piece 5 in. long is turned down at each end of each of the four support wires; this length allows 3 in. to form the height of the crown and 2 in. to twist around the head-size wire.

44. To construct the crown shown in Fig. 26, first mark the middle points *d*, *g*, *h*, and *i* of the square top as explained in connection

with the square crown. Then put on the front-to-back and the side-to-side support wires *j* and *k*, twisting them once around the top brace wire *b* at the middle points marked. Next put on the diagonal support wires, twisting them once around the top brace wire at each corner. Cut a paper gauge 3 in. in length, measure off the height of the crown from the points *d*, *g*, *h*, and *i*, and the corners of the square top, and turn up the ends of the support wires at the marks thus made. Take the head-size wire *a*, mark it off into eight equal divisions, set it on the bent-up ends of the support wires with the middle point *c* of the overlap directly beneath the point *d*, and twist the ends of the support wires around the head-size wire at the equally spaced marks. Then cut off the ends close to the wire *a* and press the twists firmly. Tie the support wires together at the middle point *l*. Finally, put on the middle brace wire *m* midway between the top brace wire and the head-size wire, and tighten all the tie wires. The brace wire *m* is 24 in. in length, with a 3-in. overlap. Less than 5 yd. of brace wire is required for this crown.

ECCENTRIC CROWNS

45. The crowns that have been described in the foregoing articles are the standard forms in most common use; but they do not by any means include all forms. The odd, irregular shapes that are made to carry out the ideas of designers and to produce unusual effects are known as **eccentric crowns,** and their number and differences render it impossible to give instructions for making them. As far as the details of the work are concerned, eccentric crowns involve many of the operations that are used in constructing the standard forms; however, it is necessary to adapt these operations to the altered conditions imposed by the change from a regular to a very irregular shape.

SKELETON FOUNDATIONS
(PART 1)

EXAMINATION QUESTIONS

(1) What is the construction of ordinary ribbon wire?

(2) What is meant by the head-size?

(3) Why is it not advisable to use uncovered tie wire?

(4) How is edge wire covered?

(5) Of what two materials are frames made?

(6) For what purpose is cable wire used?

(7) Explain how to obtain the head-size, using a piece of brace wire.

(8) Explain how a paper gauge is made to divide a head-size wire into eight equal parts.

(9) What is meant by a foundation?

(10) Explain the operation of springing the wire, and tell why it is done.

(11) How may tie wire be prevented from uncoiling from the spool?

(12) Where should the starting point be in marking off the equal divisions on the head-size wire?

(13) For what purpose is brace wire used?

(14) Name the uses of the pliers.

(15) Which size of brace wire is most commonly used?

(16) For what purpose is ribbon wire used?

(17) Explain how a number of short tie wires may be cut with the shears.

(18) For what purpose is edge wire used?

(19) For what purpose is tie wire used?

(20) How much overlap should be given to the ends of the head-size wire?